WORKSHOP

TOWARDS BIO-BUTANOL AS FUEL: BIOREFINERY, PROCESSES AND TECHNOLOGIES

RESEARCH ON THE USE OF BUTANOL-GAS OIL BLENDS IN HEATING BOILERS

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INSIA UPM

WORKSHOP

INSIA: Instituto de Investigación del Automóvil (Institute for Automobile Research)

- Research and Development
- Postgraduate education
- Services to industry

- Focussed in three areas:
  1. Security of transport and vehicles
  2. Efficiency and environment of transport
     - Emissions measurement
     - Transport decarbonisation
     - Eco-driving
  3. Design and development of transport systems
     - Electric and hybrid vehicles
     - Selfdriving vehicles
     - Buses and Coaches

1. Objectives

WORKSHOP

Determine the effect on the burner and boiler performance of blending butanol (5%, 10% and 20% v/v) with commercial heating fuel.

The experimental work include four issues:

- Spray shape
- Thermographic analysis of the flame structure.
- Boiler performance
- Pollutant emissions

In collaboration with

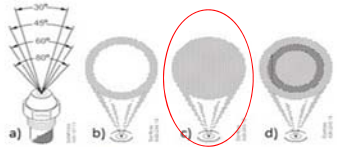
LOM

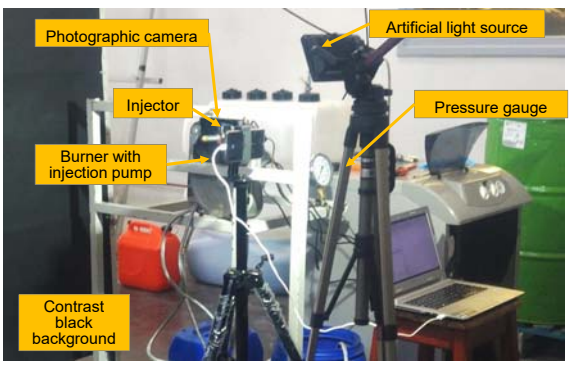
POLITÉCNICA "Ingeniamos el futuro"

2. Spray shape analysis

WORKSHOP

- Experimental setup





Danfoss boiler sprayers:

a) Available angles
b) H type (hole)
c) S type (solid)
d) B type (semisolid)

Tests of spray distribution:

- 3 boiler sprayers S type: 45º, 60º and 80º
- 3 injection pressure levels: 8, 10 and 12 bar

2. Spray shape analysis

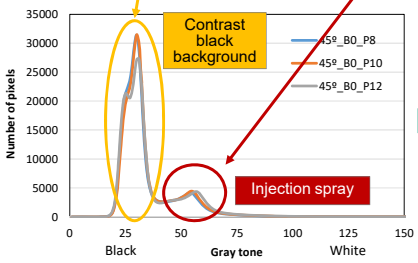
WORKSHOP

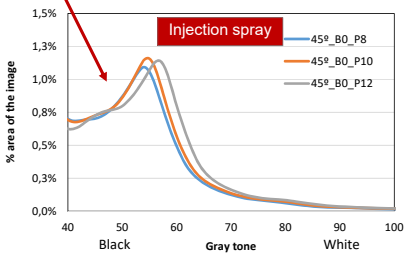
- Data processing

Visual image processing

Fiji Image J

300 photo / case





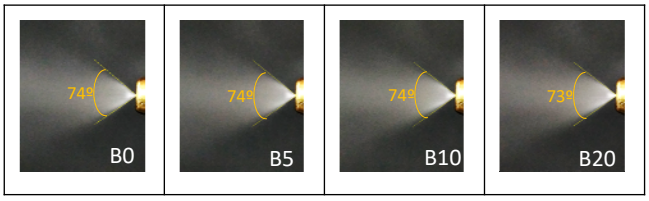
2. Spray shape analysis

WORKSHOP

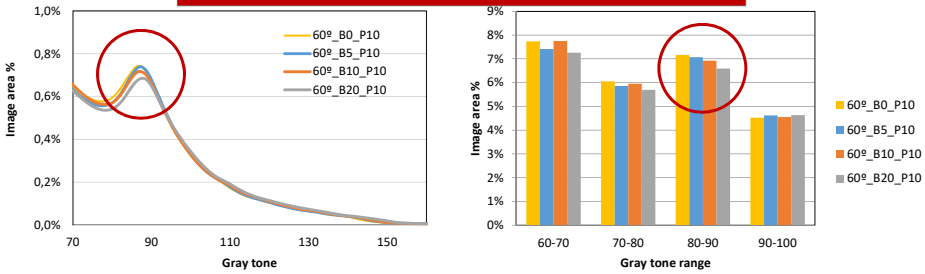
- Results

60º injector
10 bar

Jet Angle
NO CHANGE



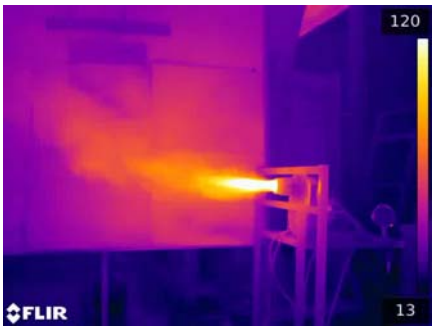
↑ % Butanol → ↓light tones → ↑evaporation

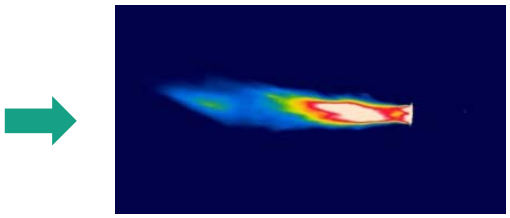


3. Thermographic analysis of the flame

WORKSHOP

- Experimental setup



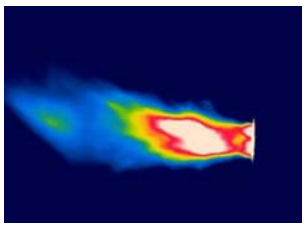


60º sprayer
8, 10 and 12 bar
5 images/case

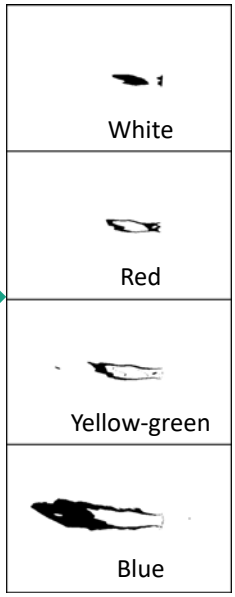
3. Thermographic analysis of the flame

WORKSHOP

- Data processing



Flir T1020 Thermographic camera



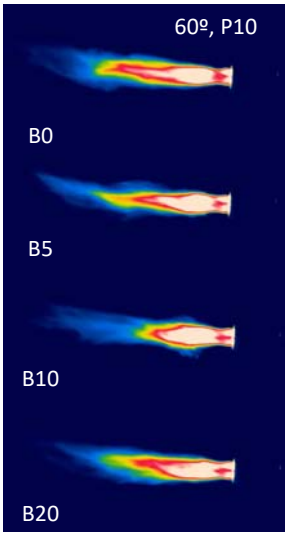
Visual image processing

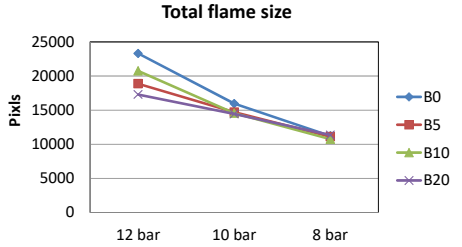
Fiji Image J

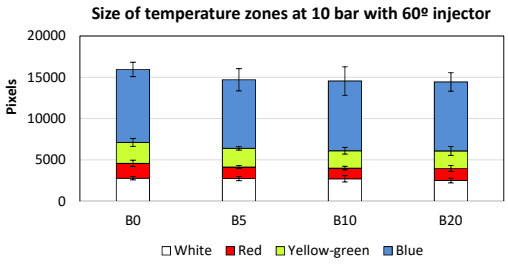
3. Thermographic analysis of the flame

WORKSHOP

- Results







↑ % Butanol → ↓flame size

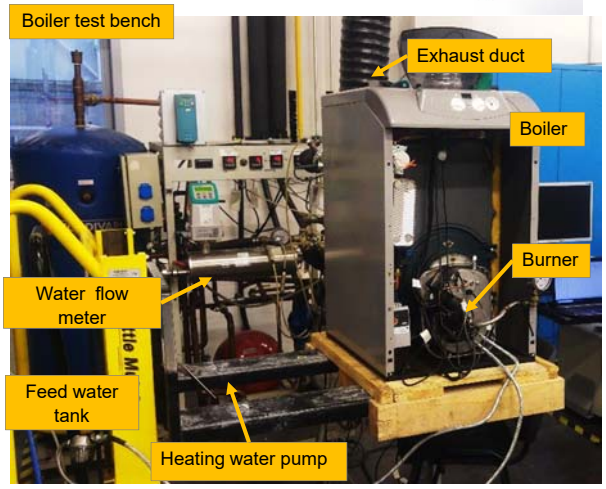
4. Boiler performance

WORKSHOP

- Experimental setup

Atlas 30 unit

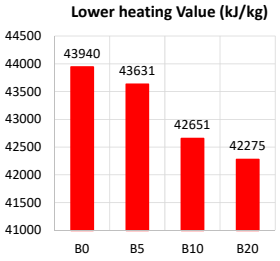
Ferroli

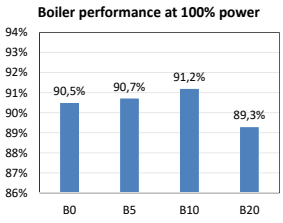


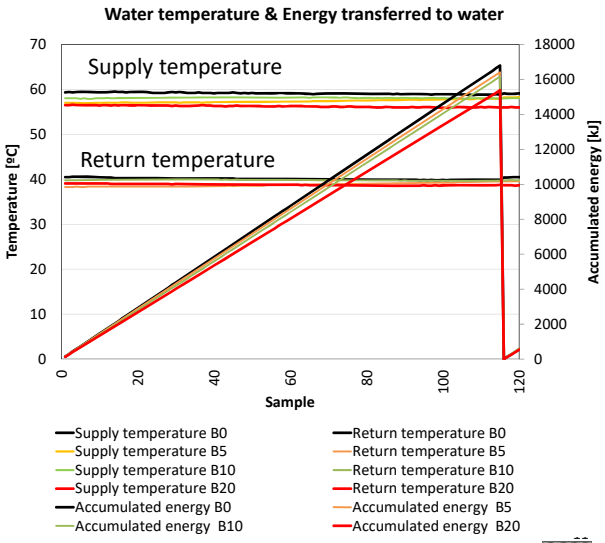
4. Boiler performance

WORKSHOP

- Results



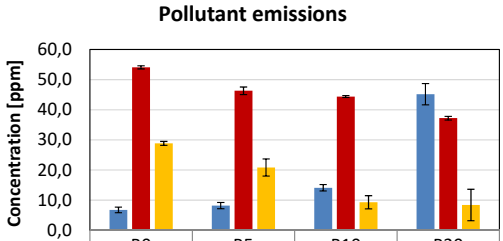




5. Pollutant emissions

WORKSHOP

- Experimental setup and results



	B0	B5	B10	B20
CO	6,7	8,2	14,1	45,2
NOx	54,1	46,3	44,4	37,2
SO2	28,9	20,8	9,3	8,4

6. Conclusions

WORKSHOP

- Butanol – heating fuel blends up to 20 % v/v can be used in commercial burners and boilers
- No significant effects on injection spray shape and flame structure with butanol blends up to 20 % v/v
- Better boiler efficiency with 10 % v/v blend
- The increase in butanol % affect the pollutant emission concentrations in the exhaust gases:
  - NO_X decreases
  - CO increases
- Future
  - More deep analysis of results
  - Simulation model of burner flame
  - Burner components duration

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Thank you for listening!

Jesús Casanova

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Partners

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